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(54) Cell circuit interrupter.

(57) The present invention provides galvanic cells having a failsafe circuit interrupter means for electrically isolating one cover terminal of the cell from the cell's electrochemical system when the closed end of the container of the cell bulges beyond a predetermined amount, the cover having a flange to grip the closed end of the container but being insulatingly supported on the end of the container, so that when the end of the container bulges, the grip of the flange is broken, thereby breaking the circuit.

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CELL CIRCUIT INTERRUPTER

The present invention relates to galvanic cells having a fail-safe circuit interruption means for electrically isolating one terminal of the cell from the cell's electrochemical system when the closed end of the cylindrical container bulges beyond a predetermined amount.

Galvanic cells, such as alkaline cells, are generally designed to vent when the internal pressure exceeds a predetermined amount. When exposed to an abuse condition, such as being charged to an excessive degree, the cell is designed to vent and allow gas to escape. Under certain abuse conditions, electrolyte entrained in the gas may be forced from the cell. It is preferable to have the electrolyte escape rather than have the cell rupture from internal pressure build-up.

Cell manufacturers have used a number of approaches to resolve the problem of expelling electrolyte during venting. One of the most common methods of preventing seal rupture due to abuse charging or the like is to insert a diode in the battery's electrical circuit. By eliminating the possibility of charging the cells, internal gas is not generated and the seal never ruptures.

Another electrically related mechanism is a belleville shaped "flip-switch". This device is triggered by bulging of the closed end of the cell's cylindrical container which causes a washer to invert and thereby break electrical contact.

Another method involves the use of absorbants or electrolyte thickeners. The absorbant materials are usually located outside the seal area and beneath the cell's cover or jacket. As electrolyte escapes from a ruptured seal, the liquid is absorbed. Spew thickeners are mixed with the electrolyte and therefore are contained within the cell. The objective of the thickener is to slow down and/or absorb any leakage that may occur. The disadvantage of using either an absorbant or thickener is that both materials tie up space that otherwise could be used for active materials of the cell.

A third procedure is to use an outer container and end covers as an electrolyte containment system, providing space to contain the electrolyte that may escape.

U.S. Patent No. 3, 676.221 discloses a battery comprising a plurality of stacked, disc-like, sealed cells secured together by cups fitted over one cell and having bottoms spot-welded to the next cell and sidewalls spot-welded to the interfitting cell. A heat-shrunk sheath encloses the battery and has caps forming the poles. Between each pair of cells is a circular disc of insulating material against which the cup bottoms bulge upon expansion of the contents of the cells, thereby breaking the welds and electrically disconnecting the cells.

U.S. Patent No. 4,025,696 describes a disc-shaped washer which inverts after the bottom bulge exceeds a predetermined value. Prior to activation, the washer's inside diameter is slanted toward the container. As the container bulges, the bottom of the container pushes against the washer and eventually causes the washer to invert. This inversion electrically separates the bottom cover from the container. An open circuit is the net result.

U.S. Patent No. 3.775.661 describes a cell in which internal pressure forces a diaphragm against a switch which electrically disconnects a charging device. The diaphragm is located inside a venting device which is attached to one end of the cell.

U.S. Patent No. 2.651.669 describes a bulge-activated switch that can be incorporated into a single cell battery or a multiple cell battery and operable such that the bulge can be used to open a switch, or switches, that control the cell's discharging and/or charging circuits.

U.S. Patent No. 3.617, 386 describes a cell in which a thin sheet of metal with "spring back" ability is positioned between the seal and cover of the cell so as to break the cell's electrical circuit when the bulge becomes excessive.

U.S. Patent No. 3.081,366 describes a sealed cell having a metallic sheet member connected to one cell electrode and its periphery insulatingly affixed to an open casting end and an overlying exposed metallic terminal insulatingly held over the sheet member. A movable switch portion normally connects an intermediate pressure deflectable sheet member portion to the external terminal and, in response to outward motion of the deflected sheet portion under excess internal pressure the switch portion disconnects the external terminal from the deflected sheet portion.

U.S. Patent No. 3,373,057 describes a cell in which the cover of the casing of the cell is provided centrally with an inwardly-concave contact button. A dished (concaveconvex) snap-acting spring disc of the automatic reset type is marginally sealed to the inside of the cover. An automatic reset disc, after snapping in one direction in response to pressure on its convex side, will return with snap action when the pressure is relieved. The disc is provided centrally with a sealed movable contact for engagement and disengagement with an internal fixed contact when the disc snaps to and fro. The arrangement is such that when the contacts are engaged the disc is slightly sprung toward the cover but short of causing snap action. This maintains good electrical contact pressure under safe internal gas pressure. The fixed contact is

electrically connected with one set of battery plates and the other set of plates is electrically connected with the casing.

U.S. Patent No. 4,690,879 describes a cylindrical galvanic cell employing a unitary type cover welded to the container as a fail-safe circuit interruption means. This electrically isolates one terminal of the cell from the cell's electrochemical system when the bottom of the cylindrical cell bulges beyond a predetermined amount, causing the unitary cover to break electrical contact with the housing of the cell.

In a first aspect, the present invention provides a sealed galvanic cell of the type wherein the active components are contained in a conductive container, a cover over the open end of the container providing one terminal a conductive flanged, preferably rigid, second cover being insulatingly supported on the closed end of the container, the flanged, optionally interrupted, being adapted, preferably by an interference fit, to grip the container to provide electrical contact and thereby providing a second terminal, and wherein the battery circuit is breakable when the end of the cell bulges a predetermined amount, breaking the grip of the flange.

In an alternative aspect, the present invention provides a sealed galvanic cell comprising a conductive container having an upstanding wall open at one end and closed at the opposite end and including in said container a positive electrode, a negative electrode and an electrolyte, said conductive container being in electrical contact with one of said electrodes; a first cover mounted over said open end of said conductive container, said first cover being secured to, and electrically insulated from, said conductive container and in electrical contact with the other electrode; an electrically insulating material disposed at the central area of the closed end of the conductive container leaving the external surface of the upstanding wall adjacent the closed end ot the conductive container exposed; a rigid conductive second cover terminating with a dependent flange such that the rigid second cover forceably slides onto and is secured to the closed end of the container by an interference fit between the dependent flange and upstanding wall adjacent the closed end of the container, thereby adapting said second cover as the terminal for the electrode in electrical contact with said conductive container; and wherein the closed end of the conductive container will bulge upon a predetermined pressure build-up within the conductive container to force the second rigid cover to slide off the container and break the electrical contact between the inner surface of the dependent flange and the outer surface of the upstanding wall thereby breaking the electrical contact between the second rigid cover and the electrode in electrical contact with said conductive container.

Thus, the advantages of the present invention include the provision of galvanic cells with means for electrically isolating one terminal from the cell's electrochemical system upon reaching a predetermined bulge in the cell's housing, which cells have only a minimum space requirement so as not to diminish the space allocated for the active components of the cell, and which are easy to make, cost-effective and easy to assemble.

The present invention effectively eliminates electrolyte leakage due to abusive charging or over-discharging, does not require an additional electrical component, is relatively simple to incorporate into a manufacturing process, and effectively does not take up any usable space within the cell's interior.

The main point of the invention is that the second cover will break the circuit by losing electrical contact with the end of the container when the container bulges. This is essentially achieved by providing a cover with a flange disposed so as to be able to grip the end of the container on which the cover is mounted.

The second cover must generally be made of a rigid material, or be supported in a rigid manner, so that when the container bulges, it does not bend to retain contact with container. The less grip the flange has on the container, the less rigid needs be the cover, but this tends also to lead to less well def ined function in that it becomes less easy to predict how much bulge is necessary to break contact.

Although it is not essential, it is generally preferred that the flange be located about the periphery of the cover which, in turn, is shaped in accordance with the end of the container.

The second cover need not be flat, especially where the end of the container is not flat, but, in a preferred embodiment, the container has walls substantially at right angles to its closed end, and the second cover effectively covers the end of the container with the flange gripping the container walls.

The flange need not be continuous, provided that electrical contact is effected. At the very least, the flange comprises two opposed fingers, but this embodiment is not preferred, as the fingers are prone to deformation, unless particular care is taken if the cover is made of particularly rigid material. Covering the flange with a shrink-wrap can help to overcome this problem.

Gripping of the end of the container does not need to involve anything more than a good electrical fit, but this may not provide enough resistance to bulge and may stress the insulating support unduly. Therefore it is preferred to use an interference fit where appropriate.

By 'interference fit, is meant a fit between members where the male part of the one member is mathematically too large to mate with the female part of the other. The difference should not generally be too great, as otherwise no mating could be effected with excessive deformation of one or the other member. It will also be appreciated that it is generally preferable not to make all of the dimensions of the male part too large for the female, but only parts. Thus one or more projections on one or both of the mating portions will generally suffice. It is preferable that such projections correspond to a recess in the other member so that, when mated, the two members are held firm but without causing undue stress to either member. It will be appreciated that variations on the theme are virtually infinite and will, in any event, be apparent to one skilled in the art.

An interference fit between the second cover and the closed end of the container can be obtained by having a projected area defined on the inner surface of the dependent flange and disposed perpendicular to the longitudinal axis of the container overlap a projected area defined on the external surface of the upstanding wall of the container adjacent the closed end of the container and disposed perpendicular to the longitudinal axis of the container.

In a preferred embodiment of the invention, the interference fit of the second cover of the closed end of the container is effected by having a positive disturbance, such as a rim spaced apart projected tips, or longitudinal ribs, in the external surface of the upstanding wall of the container adjacent its closed end and/or in the internal surface of the dependent flange of the second cover. When using this arrangement, the positive disturbance should provide an interference fit when the cover is forceably slid onto the closed end of the container. When using a projected rim on the internal surface of the depending flange, a groove may be disposed in the external surface of the container so that the cover can be forceably slid on the container until the projected rim snaps into the groove of the container. This rim and groove arrangement is one form of interference fit in accordance with the invention. A positive disturbance in the inner surface of the dependent flanged such as mentioned above, is also sufficient to provide the interference fit when forcibly slid onto the smooth surface of the upstanding wall of the container adjacent the closed end of the container.

Another embodiment of this invention is a sealed galvanic cell comprising a conductive container having an upstanding wall open at one end and closed at the opposite end and including in said container a positive electrode, a negative electrode and an electrolyte, and said conductive container being in electrical contact with one of said electrodes; a first cover mounted over said open end of said conductive container, said first cover being secured to and electrically insulated from said conductive container and in electrical contact with the other electrode; an electrically insulating material disposed at the central area of the closed end of the conductive container leaving the external surface of the upstanding wall adjacent the closed end of the conductive container exposed said external surface of the upstanding wall adjacent the closed end of the container having a surface disturbance; a rigid second cover terminating with a dependent flange in which the internal surface of the dependent flange has a surface disturbance adapted for mating in engagement with the surface disturbance on the upstanding wall such that when the second cover is placed onto the closed end of the container the disturbance in the flange will snap into engagement with the disturbance of the upstanding wall of the container so that the second cover is secured onto and in electrical contact with the container thereby adapting said second cover as the terminal for the electrode in electrical contact with said conductive container; and wherein the closed end of the conductive container will bulge upon a predetermined pressure build-up within the conductive container to force the second cover to unsnap and slide off from the container which will break the engagement between the disturbance in the flange and the upstanding wall of the container thereby breaking the electrical contact between the second cover and the electrode in electrical contact with said conductive container.

The term "surface disturbance" includes: a groove; at least one dimple; at least one extending projected tip or longitudinal rib: a projected circumferential rim; or any combination thereof. The groove, projected rim may comprise two or more spaced apart grooves or rims, respectively, encompassing an arc-type segment on the external surface area of the upstanding wall of the container or on the internal surface of the dependent flange of the second cover. If a groove is disposed on the upstanding wall of the container then a projected rim may be disposed on the internal surface of the flange so that the projected rim could snap into the groove in the upstanding wall thereby securing the cover to the container. In a similar manner, the groove could be disposed on the internal surface of the flange and the projected rim could then be disposed on the external surface of the upstanding wall of the container.

Likewise, if at least two spaced apart dimples are disposed on the container then at least two spaced apart projected tips could be disposed on the inner surface of the flange of the cover. If spaced apart projected tips were disposed on the

container then spaced apart dimples could be disposed on the inner surface of the flange of the cover. If desired, a groove could be disposed on the upstanding wall of the container in which two or more spaced apart projected tips could be disposed on the inner surface of the flange of the cover.

When using a disturbance in the cover and a disturbance in the container, the disturbances should be adapted for mating engagement so that the flange of the cover can be forceably slipped over and onto the closed end of the container in an interference fit and then snapped into securing engagement so that the cover is secured onto and in electrical contact with the container. The type of mating disturbance on the upstanding wall of the container and the flange of the cover is selected so that when a predetermined pressure build-up within the container occurs, the closed end of the container will bulge and dislodge or unsnap the disturbances and then slip the cover off from the container so that the electrical contact between the container and cover is broken. The particular type of combination of disturbances will depend on the material used for the container and/or cover, the degree of the disturbance in the surface of the container and/or cover, and the force required to unsnap or disengage the disturbances. Thus, by selecting the appropriate type of disturbances for the cover and container of a particular size cell and cell system, the cell can be made to vent at a predetermined pressure bulid-up within the cell.

Preferably the groove or dimple should be disposed in the upstanding wall of the container with the rim or projected tip being disposed in the internal surface flange of the cover so that when the cover is forceably slid onto the closed end of the container and the rim or tip snaps into the groove or dimple, respectively, the external surface of the flange will be free of projections. Another preferred embodiment of the invention has the upstanding wall of the container adjacent the closed end of the container indented by an amount equal to or greater than the thickness of the flange of the cover. In this embodiment, when the cover is forced onto the closed end of the container, the flange of the cover is placed onto the indented portion of the container so that the flange is in alignment with the overall circumferential surface of the container. This produces a cell having a relatively constant outer peripheral wall.

As used wherein the electrically insulating material may be a disc made of plastic tape, paper, ceramic or it may be a layer of an electrically nonconductive adhesive. It is possible that the disc itself provides the insulating support, for examples by having an integral ceramic portion.

When the insulating material is a disc, the disc may be conductive or nonconductive provided that, if it is conductive it is secured to the closed end of the conductive, container using a nonconductive adhesive. In some applications the disc may also be secured to the conductive cover by conventional means.

The conductive cover is preferably rigid so that as the closed end of the container bulges, the conductive cover will remain relatively flat thereby assuring that it will slide or unsnap so that the cover will break electrical contact with the conductive container. Thus, the bulge of the closed end of the container is sufficient to slide the cover from the container and force the flange of the conductive cover away from and to be electrically insulated from the conductive container.

The insulating material may be an electrically nonconductive adhesive that secures the inner area of the conductive cover to the closed end of the container. Suitable nonconductive adhesives for this invention are acrylic type adhesives, epoxy type adhesives and cyanoacrylate type adhesives. Also suitable are hot melt adhesives such as asphalt. Another suitable nonconductive adhesive is double-sided tape.

The nonconductive adhesive should be applied so that it bonds the conductive cover to the closed end of the container with sufficient strength to prevent tipping of the conductive cover when the cell bulges. In addition, the nonconductive adhesive must allow direct electrical contact to be made between the upstanding wall adjacent the closed end of the container and the peripheral flange of the conductive cover. If desired a plastic film may encase the cell and extend over the edge of the conductive cover. The plastic film may be a conventional heat-shrinkable film made from a material such as polyvinyl chloride, polyvinylidene chloride and polyolefins such as polyethylene and polypropylene.

In a preferred embodiment, the container is a cylindrical container, the electrically insulating material is a nonconductive adhesive and the conductive cover is a disc-shaped member with a dependent flange.

The simple design of the circuit interrupter means of this invention provides a number of unique features. First, when a nonconductive adhesive is employed, it may easily be applied as a layer between about 0.01 inch (0.254mm) and about 0.02 inch (0.508mm) thick. Thus the circuit breaker means will generally require little or no additional space within the cell since the conductive cover can function as a cover for the cell.

In a preferred embodiment, an electrically nonconductive adhesive is used to secure only a portion of the conductive cover to the container. This adhesive performs two functions. First, the adhe-

sive holds the cover substantially perpendicular to the cell's longitudinal axis and second, the adhesive electrically insulates the cover from the conductive container after the closed end of the container bulges and breaks electrical contact between the flange of the conductive cover and the container.

In some applications, the control of the degree of bulge to slide or unsnap the flange of the cover from the container may be somewhat critical. For commercial applications, the flange should not be unsnapped or slid from the container when the amount of the bulge is that which might normally occur when the cell is subject to high temperature storage. Thus, the degree of bulge required should generally be beyond the normal bulge that can be encountered in such high temperature storage but below the degree of bulge that will break the seal and let electrolyte escape. For example, in a standard type alkaline D-size cylindrical cell (2.277 inches [57.84mm] high and 1.318 inches [33.48mm] diameter), the bottom of the container can bulge as much as 0.025 inch (0.635mm) when stored at 71°C for an eight (8) week period and can vent when the bulge exceeds 0.070 inch (1.778mm). Consequently, for this size and the cell system, the interference fit is preferably selected so that the second cover generally slides off the container when the bulge in the closed end of the container is between about 0.030 (0.762mm) and about 0.070 inch (1.788mm).

This invention is ideally suited for alkaline cells employing a MnO_2 positive electrode, a zinc negative electrode and an electrolyte solution comprising potassium hydroxide.

The present invention will now be illustrated with respect to preferred embodiments shown in the accompanying drawings in which:

Figure 1 is an elevation, partially in cross-section, of an alkaline manganese dioxide/zinc cell embodying a circuit interrupter means of the present invention;

Figure 2 is an elevation of part of the cell of Figure 1 showing the bottom, closed end of the container with a slight bulge insufficient to lift the cover away from contact with the container;

Figure 3 is an elevation of part of the cell of Figure 2 showing the cover lifted off the container;

Figure 4 is an enlarged fragmentation view of another embodiment of the invention showing a circuit interruption means of the present invention;

Figure 5 is an enlarged fragmentation view of another embodiment of the invention showing a circuit interruption means of the present invention; and

Figure 6 is an enlarged fragmentation view of yet another embodiment showing a circuit interruption means of the present invention.

In Figures 1-3 a typical alkaline galvanic cell 10 of the present invention is shown comprising an inverted metallic cupped container 12 provided, if desired, with an outer plastic shrink film 14. Disposed within the container 12 is an anode 16, a cathode 18, a separator 20 and an alkaline electrolyte which permeates the anode 16, cathode 18, and separator 20 respectively. An anode current pin type collector 24 extends lengthwise within the cell 10, parallel to the longitudinal axis of the cell from a location in contact with the anode 16 to the negative end 2 of the cell 10 where it terminates.

A cup-shaped cover 28 is shown with its peripheral depending flange 30 secured onto the peripheral area of the upstanding wall of container 12 through the use of projected rim 31 on the inner surface of flange 30 mating within the groove 33 disposed on the upstanding wall of container 12. Prior to placing cover 28 onto the container 12, an electrically nonconductive adhesive 32, such as asphalt, is placed between the closed end of container 12 and cover 28 over an area sufficient so that only the inner area of cover 28 will contact the electrically nonconductive adhesive 32, thereby leaving the inner surface of flange 30 of cover 28 in electrical contact with the upstanding wall of container 12. Shrink film 14 can then be shrunk over the cell and onto the peripheral area of cover 28.

Figure 2 shows the beginning of the bulge in cell 10 but insufficient to lift cover 28 away from container 12 to unsnap and slide the rim 31 and groove 33 securing engagement in which the cover 28 is in electrical contact with the container.

After a predetermined amount of bulge occurs that is designed to unsnap and slide the rim on flange 30 of cover 28 out from the groove 33 in the upstanding wall of container 12, the cover 28 slides away from electrical contact with container 12 as shown in Figure 3. As evident from Figure 3, cover 28 is still secured to container 12 via electrically nonconductive adhesive 32, but its electrical contact is broken, thereby electrically isolating cover 28 from the container 12. By designing the degree of bulge to unsnap and slide the cover from the container 12, the invention effectively isolates the terminal cover 28 from the circuit of the cell, prior to the cell venting or rupturing, which would cause electrolyte to escape.

Figure 4 shows another embodiment of the invention in which a cup-shaped cover 40 has a peripheral flange 42 with a plurality of spaced apart projected tips 45 extending from its inner surface. A cell container is shown as 44 with its upstanding wall indented at the closed end of the container to accommodate the thickness of the flange 42. Also shown is the nonconductive adhesive 46 disposed between the centre of cover 40 and the bottom surface 47 of container 44. In this embodiment, the

projected tips 45 provide an interference fit when cover 40 is forceably slid onto the closed end of container 44. After a predetermined amount of bulge occurs in the container 44, the cover 40 will be pushed off and slide from the container 44 to break the electrical contact with the container 44. This effectively electrically isolates cover 40 from the circuit of the cell prior to venting or rupturing.

Figure 5 shows an embodiment of the invention in which a cover 50 has a peripheral flange 52 forceably slid onto the closed end of container 54. Container 54 is shown with its upstanding wall indented to accommodate the thickness of the flange of cover 50. Also shown is the nonconductive adhesive 56 disposed between the centre of cover 50 and the bottom surface 58 of container 54. In this embodiment the projected area defined by the inner surface of flange 52 and disposed perpendicular to the longitudinal axis of container 54 is less than or overlaps the projected area defined by the external surface of the upstanding wall of container 54 adjacent its closed end (indented circumferential surface) and disposed perpendicular to the longitudinal axis of container of container 54 so that the cover 50 has to be forceably slid onto the closed end of container 54. This interference fit secures the cover 50 to container 54. After a predetermined amount of bulge occurs in container 54, the cover 50 will be pushed away and slide from container 54, thereby breaking electrical contact with container 54. This effectively electrically isloates cover 50 from the circuit of the cell, prior to venting or rupturing.

Figure 6 shows an embodiment of the invention in which a cup-shaped cover 60 has a peripheral flange 62 with a plurality of spaced apart projected longitudinal ribs 64 extending fom its inner surface. A cell container is shown as 66 with its upstanding wall indented at the closed end of the container to accommodate the thickness of the flange 62. Also shown is the nonconductive adhesive 70 disposed between the centre of cover 60 and the bottom surface 68 of container 66. In this embodiment, the longitudinal ribs 64 provide an interference fit when cover 60 is forceably slid onto the closed end of container 44. After a predetermined amount of bulge occurs in the container 66, the cover 60 will be pushed off and slide from container 66 to break electrical contact with container 66. This effectively electrically isolates cover 60 from the circuit of the cell, prior to venting or rupturing.

Claims

1. A sealed galvanic cell of the type wherein the active components are contained in a conductive container, a cover over the open end of the container providing one terminal, a conductive flanged, preferably rigid, second cover being insulatingly supported on the closed end of the container, the flange, optionally interrupted, being adapted, preferably by an interference fit, to grip the container to provide electrical contact and thereby providing a second terminal, and wherein the battery circuit is breakable when the end of the cell bulges a predetermined amount, breaking the grip of the flange.

2. A cell according to claim 1 wherein the flange grips the container in an interference fit.

3. A cell according to claim 1 or 2, wherein the internal surface of the flange and/or the external surface of the container adjacent the closed end has at least one projected disturbance.

4. A cell according to claim 3, wherein the projected disturbance comprises a projected tip, a projected longitudinal rib and/or a projected circumferential rim.

5. A cell according to any preceding claim, wherein either a) the the external surface of the container has a groove and the internal surface of the flange has a rim, or b) the external surface of the container has at least two spaced apart dimples and the internal surface of the flange has at least two spaced apart projected tips, or c) the external surface of the container has a groove and the internal surface of the flange has at least two projected tips.

6. A cell according to any preceding claim, wherein the second cover is insulatingly supported by an electrically insulating material, preferably an electrically nonconductive adhesive, especially acrylic adhesive, cyanoacrylate or epoxy adhesive, a hot melt adhesive, especially asphalt, or double-sided tape.

7. A cell according to any preceding claim, wherein the container is a cylindrical container.

8. A cell according to claim 7, wherein the container has a groove as defined in claim 5 composed of at least two spaced apart arcuate grooves.

9. A cell according to any preceding claim wherein the surface of the flange comprises a disturbance adapted for mating with a surface disturbance on the external wall of the container.

10. A cell according to any preceding claim wherein the container is in electrical contact with a positive electrode and the first cover electrically insulated from the container is in electrical contact with a negative electrode, or vice versa.

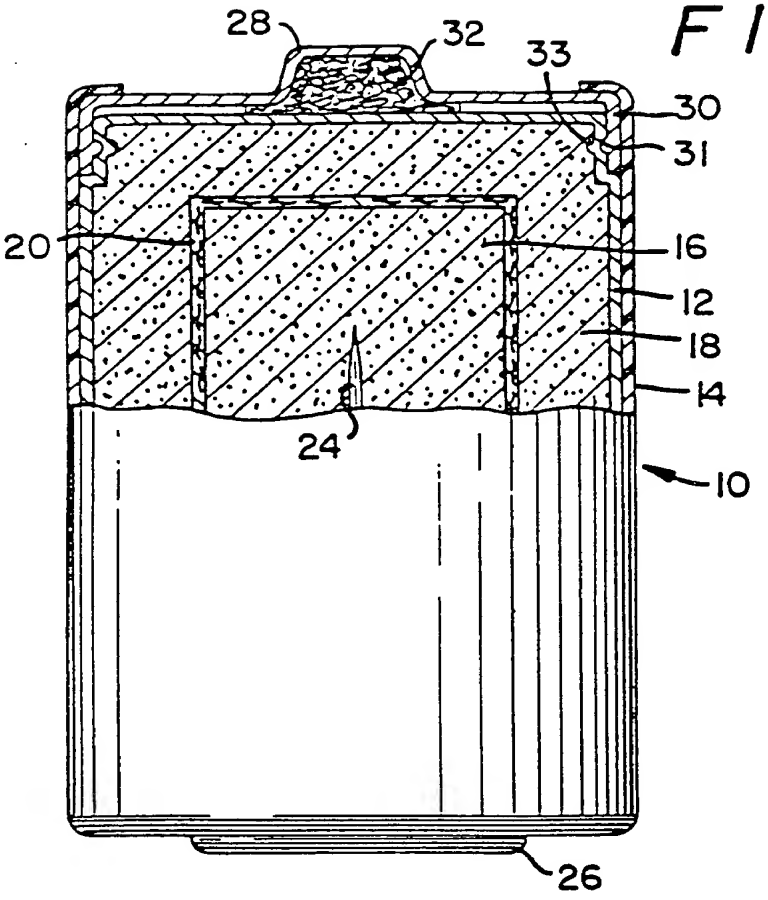
11. A cell according to any preceding claim, wherein one electrode is MnO_2, another is zinc and/or the electrolyte solution comprises potassium hydroxide.

12. A sealed galvanic cell comprising a conductive container having an upstanding wall open

at one end and closed at the opposite end and including in said container a positive electrode, a negative electrode and an electrolyte, said conductive container being in electrical contact with one of said electrodes; a first cover mounted over said open end of said conductive container said first cover being secured to and electrically insulated from said conductive container and in electrical contact with the other electrode; an electrically insulating material disposed at the central area of the closed end of the conductive container leaving the external surface of the upstanding wall adjacent the closed end of the conductive container exposed, a rigid conductive second cover terminating with a dependent flange such that the rigid second cover forceably slides onto and is secured to the closed end of the container by an interference fit thereby adapting said second cover as the terminal for the electrode in electrical contact with said conductive container; and wherein the closed end of the conductive container will bulge upon a predetermined pressure build-up within the conductive container to force the second cover to slide off and break the electrical contact between the inner surface of the depending flange and the outer surface of the upstanding wall, thereby breaking the electrical contact between the second cover and the electrode in electrical contact with said conductive container.

13. A cell according to claim 12 having any or all of the parameters defined in any of the preceding claims, or vice versa.

FIG. 1



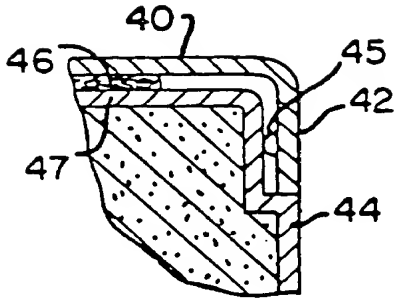
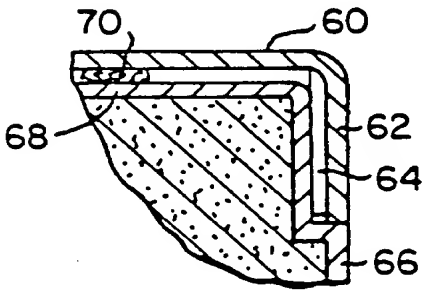


FIG. 4

FIG. 6



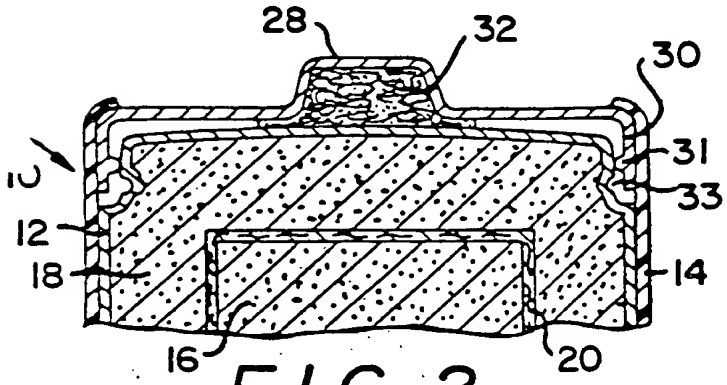


FIG. 2

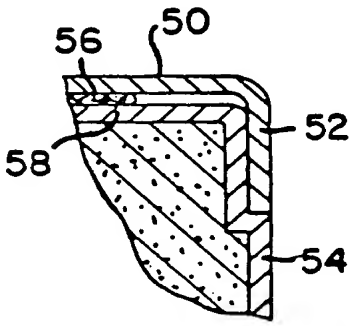


FIG. 5

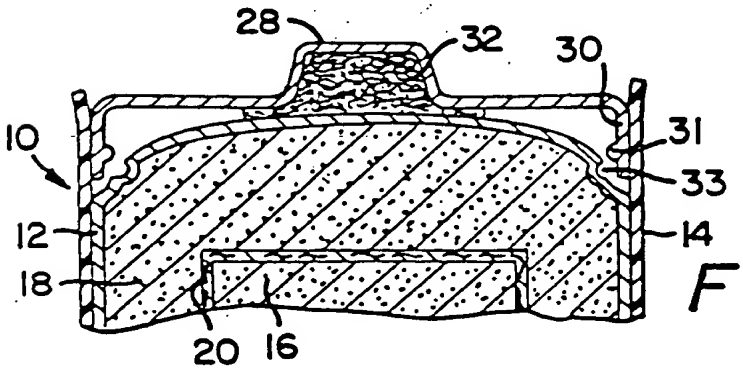


FIG. 3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 89 30 7652

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
D,A	EP-A-0 270 385 (EVEREADY BATTERY CO.) * Whole document *	1-13	H 01 M 2/34
D,A	US-A-3 676 221 (W.H. BACH) * Whole document *	1-13	
A	DE-A-2 042 417 (UNION CARBIDE CORP.) * Pages 5-9 *	1-13	
A	EP-A-0 184 648 (VARTA BATTERIE AG) * Whole document *	1-13	
A	GB-A-2 129 604 (DURACELL INTERNATIONAL INC.) * Abstract; page 1, lines 38-72 *	1-13	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

H 01 M 2/34
H 01 M 2/12

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	28-12-1989	DE VOS L.A.R.

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